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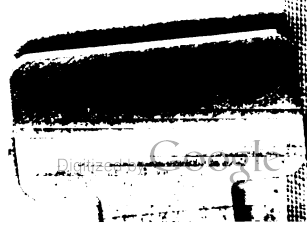
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INSTRUCTIONS FOR MOUNTING,
USING, AND CARING FOR

6-INCH RAPID-FIRE GUN, ARMSTRONG

AND

6-INCH BARBETTE CARRIAGE, ARMSTRONG

—
THREE PLATES
—

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INSTRUCTIONS

FOR

MOUNTING, USING, AND CARING FOR 6-INCH R. F. GUN, ARM- STRONG, AND 6-INCH BARBETTE CARRIAGE, ARMSTRONG.

(The points in italics are of importance, or concern the safety of the carriage, and should be specially noted.)

DESCRIPTION OF GUN.

(Plate I.)

Caliber	6 inches.
Weight	6 tons 12 cwt.
Length:	
Bore	240.0 inches.
Rifling	214.7 inches.
Chamber	23.0 inches.
Total	249.25 inches.
Rifling:	
Number of grooves	24
Spiral	increasing from 0 to 1 turn in 30 calibers.

The gun is constructed entirely of steel, and is designed for obtaining great rapidity of fire. For this purpose it is mounted in a special mounting, and is not provided with trunnions, but is carried by a cradle, which encircles the gun, and in which it slides when recoiling. This cradle is provided with trunnions, on which the gun and cradle are balanced: The breech of the gun is surrounded by a breech ring, which has a projecting arm on it for connecting the gun with the recoil cylinder, which forms part of the cradle. The mechanism for closing the breech is on the interrupted-screw system, so arranged that it can be quickly opened or closed by a single movement. The gun is provided with electrical firing gear, connected with an electrical pistol fixed to the mounting in a convenient place, so that the man laying the gun can fire while looking over the sights. It is also provided with a percussion arrangement for mechanical firing in case of failure of the electrical gear. The gun sights are fixed to the gun cradle and do not therefore recoil with the gun. The powder is contained in a metallic cartridge case, the base of the projectile resting against the front end of this case.

(Plate I.)

The breech of the gun is closed by a screw formed in two steps, the front step being tapered, and of less diameter than the rear; both steps have three portions of their thread removed, each one-sixth of a turn, the threads on one step standing opposite to the blank spaces on the other; this arrangement distributes the strain all round the circumference of the breech screw. The interior of the gun at the breech is prepared in a similar manner, and admits of the breech screw being swung into place and locked by a simple mechanism, to be described.

The breech screw is supported by a carrier, *P*, on which it is free to revolve through an angle of 60 degrees; the carrier is hinged to the right side of the breech ring, so that the screw can swing clear of the breech opening for loading. The screw is secured on the carrier by means of the stop bolt *D*. The breechblock is unscrewed and withdrawn from the gun by a single horizontal movement of the hand-locking lever *L*, which is pivoted on the right side. A projecting pin *P*¹ is screwed into the rear face of the breech screw, and enters a traversing bush *P*² in the sliding block *N*. This block slides in a seat in the carrier, and is connected to the hand-locking lever *L* by the link *N*¹. When the breech is open, the screw is prevented from turning on the carrier by a spring catch, *M*, on the carrier, which engages a notch *M*¹ in the screw, as it is withdrawn from the gun; when closing the breech the catch comes in contact with the face of the gun, thus releasing the screw and leaving it free to be screwed home.

It is impossible to fire the gun until the breech is completely locked; this is insured by means of a safety gear, consisting of a safety lever, *F*, pivoted to the block carrier *P*. The safety lever engages a lug, *R*, on the rear end of the firing pin, and is actuated by a plunger, *S*. The safety lever prevents the firing pin from touching the primer while the hand lever *L* is in the unlocked position.

The striker is secured in the carrier by the retaining nut *K*, and can be readily removed by slightly withdrawing it and turning the nut a quarter of a turn.

To fix the striker it is pushed into the gun, and the retaining nut turned to the right or left.

The upper end of the spindle *F*² is held in place by a screw countersunk in a housing, *H*. The spindle with its torsional spring and spline key locks the operating handle when closed, and should the

spline key be broken it will interfere only with this function but in no way affect the safety features of the mechanism.¹

The safety lever which engages behind the retracting toe R , mounted on the rear end of the firing pin, is fulcrumed at its outer end to the block carrier P at a point F^1 . The safety lever controls the motion of the firing pin during the opening and closing of the block, and is operated by the intermediate safety-lever plunger S , which passes through a hole in the block carrier and rests against the rear face of the breechblock. In opening the block the safety plunger is forced outward and to the rear by the screw motion of the block; it slowly forces out the safety lever, at the same time retracting the firing pin. The safety-lever plunger is made adjustable in length to provide for wear and control of the movement of the firing pin.

This adjustment is to be so made and maintained that in closing the block the firing pin will begin to protrude from the face of the block when the operating lever is closed to a position about 1 to 3 inches short of that where the toe of the spindle F^2 enters its groove in the operating lever.

The words "electric" and "percussion," with indicative arrows, are stamped on the rear face of the carrier to show the positions to which the retaining nut K is to be turned for firing.

For percussion firing the retaining nut K is revolved so that the firing trigger is in a horizontal position on the *right*. The loop of the trigger engages upon a knob of the lanyard connecting rod J^1 , which has at its outer end a loop in which the lanyard is to be habitually hooked. The object of this arrangement is to prevent the trigger from being used on the left side for percussion firing where no safety cock is provided. The right-hand position for percussion firing was selected in preference to the left-hand position, it being deemed most convenient for the service of the piece to pull the lanyard from the right.

A half-cock notch has been made in the right side of the firing-pin sleeve. In opening the block the firing pin is retracted by the safety lever to such an extent that the half-cock notch is held out a little beyond the trigger J . On closing the block the firing pin is caught in the half-cock notch by the trigger and prevented from coming in contact with the primer. To fire the piece the pin will be drawn to a full cock by hand. This safety cock forms in itself a full safeguard against premature discharge for percussion firing.

For electric firing the retaining nut K is revolved so that the firing trigger is in a horizontal position on the *left*. The firing-cable attachment is on the right. A full-cock notch is made on

¹ As originally constructed, the spindle F^2 with its levers was the safety lock for the firing pin as well as the lock for holding the operating lever closed.

this side of the firing-pin sleeve, although not needed for electric firing. No half-cock notch is made, as it would interfere with electric firing, necessitating the release of the firing trigger and freeing the firing pin after closing the block for every discharge. The full-cock notch is made on both sides of the firing-pin sleeve to avoid a possible accident, namely, the slipping of the firing pin from the hand if one attempted to cock it in the absence of any sear notch. By leaving the full-cock notch on this side it will also be possible to fire the piece by percussion with the firing trigger on the left. This is not intended and should be avoided unless the space in the emplacement is such as to necessitate pulling the lanyard from the left side. In such cases the safety feature for half cock is lost and reliance must be placed upon the safety lever. In closing the breech with the firing trigger to the left (where there is no half cock) the safety lever continues to restrain the firing pin, with slow motion, until the operating-lever handle has reached the nearly closed position, when the protruding firing pin comes in contact with the primer, after which the completion of the closure can cause no blow upon the primer.

The adjustment of the firing pin for point of first protrusion will be made with the firing trigger on the left, and as follows:

The firing-pin sleeve nut must be screwed fully home in order to bring the opening in the sleeve opposite the firing-cable point which is screwed upon the retracting toe piece, and thus insure contact between the cable and the stem of the insulated firing pin. It is not permissible to adjust the protrusion of the firing pin by changing the position of the sleeve nut (brass), as this would destroy the cable contact. Next, keeping the breech open, revolve the block by the operating handle, at the same time placing a finger at the front of the firing pin. If the pin does not begin to protrude so that it would press upon the primer, if in place when the operating handle has reached the position already indicated, then adjust the length of the safety-lever plunger to regulate the protrusion of the firing pin as required. The safety-lever plunger is made in two parts, with a screw shank and locking nut for adjustment of length. The arm of the firing-pin sleeve cap can be used for turning the screw, while the safety lever itself, placed in the end slot of the pin, serves as a holder.

An automatic loading tray R^1 is pivotally attached to the right side of the breech of the gun and is operated during the swinging motion of the block carrier in opening the breech by means of a cam groove formed on the block carrier.

ELECTRICAL FIRING APPARATUS.

The electrical firing apparatus consists of a battery, a firing pistol, two brackets carrying contact points, an insulated firing pin, and the

necessary cables for connecting the above parts, also an auxiliary firing cable and firing key for use in an emergency.

The firing battery consists of six O. K. dry batteries No. 4, connected in series. They are carried in a box, which is mounted in a bracket on the left side of the carriage. One terminal of the battery is connected to the firing pistol, the other is grounded by being connected to a binding post on the rear side of the battery-box bracket.

The firing pistol is secured to the bracket on the left side of the carriage. It is provided with a trigger, pressure on which completes the firing circuit, and with a buzzer to indicate whether or not the circuit is probably in good working order. The buzzer consists of a considerable length of very fine wire made up into two electro magnets. The armature of the two electro magnets is provided with a make-and-break contact piece, the vibration of which produces the buzzing sound. If the circuit be in proper working order the buzzing should begin as soon as the breech is locked after the insertion of an electric primer and should continue until the primer is fired by pulling the trigger. No buzzing should take place except with an electric primer in place and the breechblock locked. Buzzing at any other time indicates defective insulation and will run down the battery unless corrected. During the operation of the buzzer a current is flowing through the bridge wire of the primer, but the great resistance of the wire in the buzzer prevents this current from becoming great enough to fire the primer.

The pulling of the trigger establishes a parallel circuit of low resistance, and the current thereupon becomes great enough to heat the bridge wire sufficiently to fire the primer.

The two brackets carry contact pieces, through which the electrical firing circuit passes. The cable from the firing pin passes to the rear bracket, and there contact is made through the contact pieces to the cable attached to the front bracket, the other end of the latter cable being connected to the firing pistol. These brackets are detachable, and can be easily removed, thus permitting a spare cable to be readily applied if required.

An alternative electrical firing apparatus is provided, which can be quickly put into action if the other one becomes short-circuited or the insulation fails. It consists of a long cable having a taper pin at one end, which can be inserted in a hole in the rear end of the firing pin. The other end should be connected to the terminal of the battery. About the middle of the cable is a firing key, which is held in the hand of the man who lays the gun and by means of which the firing circuit can be completed.

The firing key consists of a small cylinder in each end of which is secured an insulated plug. These plugs carry contacts which are nor-

mally held apart by the action of a spring. Pressure applied to the firing key compresses the spring until the points of the plugs are brought into contact, thus completing the circuit. Before connecting the alternative cable to the battery and the firing pin, the other cables should be disconnected from those parts.

PERCUSSION FIRING GEAR.

(Plate I.)

The percussion firing gear is fitted to the retaining nut *K*, and consists of a spring trigger, *J*, with a loop to receive the knob on the lanyard connecting rod *J'*.

To fire by percussion the firing pin or needle *E* is pulled by hand to the rear until it is caught by the trigger, which retains it until the latter is displaced by a pull on the lanyard attached to the loop on the end of the lanyard connecting rod. This leaves the firing needle free to travel forward and strike the primer.

When firing with this gear the adapter is screwed into the base of the cartridge case and the percussion primer placed into its chamber in the adapter.

CARTRIDGE EXTRACTOR.

(Plate I.)

The cartridge is started by an extractor which only has sufficient motion to insure its being free for the remainder of the extraction, the conical shape of the cartridge case and chamber rendering a small motion sufficient for this purpose. The cartridge is then completely withdrawn by means of a hand extractor which readily fits over the flange of the cartridge case.

The mechanical extractor is worked by the carrier in opening the breech screw. It consists of a rod passing through one side of the gun and fitting into the groove for the rim of the cartridge case in such a manner that when it is turned about its own axis the fitted part acts as a lever and presses the cartridges to the rear.

The extractor is brought back into its place as the breech is closed by means of a strong helical spring outside the gun. This spring also serves as a buffer to prevent the breech screw and carrier being swung too violently round. The extractor is fitted on the right side, so that it is out of the way of loading or damage from a projectile when the latter is being entered into the gun.

CARTRIDGE CASE.

(Plate III.)

The cartridge case is made of brass, to the form shown on drawing. It is screw-threaded at the base for the reception of the primer

adapter. The cartridge cases of Frankford Arsenal design and manufacture are not provided with an adapter, and its mouth is closed with a lid, which is secured by three projections formed round the mouth, being turned over three corresponding notches cut round the flange of the lid. The joint round the lid is sealed by cement to render the case perfectly air-tight.

The primers used in these cases are of Frankford Arsenal design and manufacture and are known as the 110-grain electric and 110-grain percussion primers.

A saluting case is also provided for this gun containing a charge of 5 pounds of black powder. A percussion primer only is used in the saluting cases. It is of Frankford Arsenal design and is known as "20-grain saluting primer." A full description and drawings of these primers will be found in pamphlet numbered 1881, published by the Ordnance Department.

DESCRIPTION OF CARRIAGE.

The mounting consists of the following principal parts, viz:

1. Cradle, which carries the gun and in which it recoils.
2. Pivot yoke, the upper arms of which are fitted to take the trunnions of the cradle, and the stem of which forms the male part of the pivot of the carriage.
3. Pedestal, which is bolted to the emplacement and which contains a socket for receiving the stem of the pivot yoke.
4. Elevating and traversing gear.
5. Shield.
6. Day and night sights.
7. Electrical firing apparatus.

CRADLE.

The cradle is of forged steel and comprises the body, in which the gun recoils, and two trunnions. It is provided with bosses for the attachment of the sight brackets and other parts. A hydraulic recoil cylinder, two recoil-spring cylinders, and a reserve oil tank are bolted to it.

The trunnions are supported in bearings in the pivot yoke and form the axis about which the gun rotates when elevated or depressed.

RECOIL CYLINDER.

The recoil cylinder is a bronze casting, bolted to the underside of the cradle. It is provided with an air hole, an emptying hole, and a passage connecting with the reserve oil tank. The rear end is closed by a cylinder head which screws into a seat in the cylinder. A single throttling bar is provided which passes through a slot in the piston

head and is shaped to so vary the size of the opening for the passage of the liquid through the orifice as to maintain a fairly constant pressure in the cylinder during recoil. A counter-recoil buffer is provided to prevent the piece from returning into battery with too much violence.

A steel piston head, forged solid with the rod, operates in the cylinder. The rear end of the piston rod passes through a stuffing box in the cylinder head and is secured to a lug on the lower side of the gun. The stuffing box is provided with a gland and follower and is packed with two pieces of cup-leather packing.

RECOIL-SPRING CYLINDERS.

There are two recoil-spring cylinders of bronze. They are located at each side of the hydraulic cylinder and are bolted thereto. Each spring cylinder contains a column of three helical springs and a forged-steel piston. The piston rod is secured to the gun so as to move with it during recoil. The piston head is at the front end of the rod and thus serves to compress the springs during such movement.

The action in firing is as follows: The gun recoils through the cradle and carries the piston of the hydraulic cylinder and the pistons of the spring cylinders with it.

The resistance offered by the oil and by the springs gradually brings the gun to rest, after which it is returned into battery by the action of the springs.

OIL TANK.

The reserve oil tank is fixed to the cradle and is always in free communication with the recoil cylinder. Any oil lost by leakage from the cylinder is automatically supplied from the tank. A filling hole is provided at the top of the tank and a cleaning hole at the side.

INSTRUCTIONS FOR FILLING THE RECOIL CYLINDERS.

Depress the gun and remove the filling plug at the top of the reserve oil tank and the air plug, which enters the cylinder a short distance in rear of this tank. Fill through the filling hole in the reserve oil tank until the oil overflows through the air hole; then replace the air plug and fill until the oil overflows at the filling hole, after which replace the filling plug.

The quantity of oil required to fill the cylinder and reserve oil tank is about 10 quarts. Hydrolene oil of specific gravity of about 0.85 should be used in the recoil cylinder.

PIVOT YOKE.

The pivot yoke is of forged steel. It carries the cradle and forms the pivot upon which the gun and mounting revolve. A steel bracket carrying the elevating and traversing gears is attached to the left side. It also supports the shield, which is attached at each side by means of a heavy curved spring. At the base of the pivot yoke is fitted a hardened-steel ring, forming an upper path for the hardened-steel balls, upon which the mounting revolves.

PEDESTAL.

The pedestal is of forged steel. The top is bored to form a seat for the hub of the worm wheel of the traversing gear, and a pivot block is fitted into the base to receive the lower end of the revolving-pivot yoke. A ball-bearing of spherical steel balls is arranged to take the weight of the pivot and thus facilitate the traversing, a hardened-steel ring being fixed in the bearing plate, to form a lower path for the balls.

A friction clamp is located on the rear side of the pedestal for controlling the traversing. It consists of a clamp screw and handle, a pair of Belleville spring washers, and a gun-metal friction block. On tightening the clamp the friction block is pressed against the worm wheel of the traversing gear, so as to hold it stationary in the pedestal. Any wear on the screw or friction block is taken up by the spring washers. The handle of the clamp is marked with an arrow to indicate the direction of motion for tightening the clamp. Two oil pipes are provided on the pedestal, so that the pivot bearings may be readily lubricated.

ELEVATING GEAR.

The elevating gear is carried by a steel bracket fixed to the left side of the pivot yoke. It is actuated by a handwheel, placed in a convenient position to be operated by the left hand of the man laying the gun. The handwheel drives, by means of a pair of miter gears, a worm which engages the worm wheel. On the inner end of the shaft carrying this worm wheel a pinion is fixed, which gears with the elevating arc attached to the cradle.

The elevating gear is provided with a friction device, as follows: The boss of the worm wheel is hollow and contains a series of friction rings, some of which are of steel and are keyed to and turn with the pinion shaft, while the remainder are of manganese bronze and are keyed to and turn with the worm wheel. These friction rings are placed alternately and are pressed together by means of a spring-steel washer and a nut on the outer end of the pinion shaft. By

adjusting this nut the rings may be pressed together until there is produced the friction required for elevating the piece. Care should be exercised in adjusting this nut to see that it be not tightened so much as to prevent all slip in the parts in firing, as this would be likely to damage the worm or worm wheel. The nut should be set up only so tight as to prevent excessive running down of the breech in firing.

The rear face of the elevating arc is graduated in degrees and minutes and is provided with an adjustable pointer for reading the elevations. The graduations have a least reading of 10 minutes.

TRAVERSING GEAR.

The operating handwheel for the traversing gear is secured to the left side of the carriage in a convenient position for being operated by the right hand of the man at the sight. It actuates, through a pair of bevel gears, a shaft carrying a worm at its lower end, the worm and shaft being secured to the pivot yoke. The worm meshes into a worm wheel, the hub of which is centered in the top of the pedestal.

A clamp is provided which clamps the worm wheel to the pedestal, but permits the pivot yoke to rotate inside of the hub of the worm wheel.

If the clamp be set up hard it serves to clamp the worm wheel to the pedestal and prevents all traversing of the carriage.

SHIELD.

The shield is of steel and is secured to the pivot yoke by means of large flat steel springs. The shield is made up of a front piece about 3.25 inches thick, two wings about 1.25 inches thick, a flat top $\frac{1}{2}$ inch thick, and an inclined top piece about 1.5 inches thick.

An elliptical hole is provided at the front as a port for the gun and two longitudinal slots are provided in the roof to admit of the use of a sight at each side of the gun.

DAY SIGHTS.

The sight now in use with the carriage is an open sight of the bar-sight pattern with detachable electric lights for use at night. The day sight comprises the following principal parts, viz:

Sight bar with front and rear sights attached thereto, carrier, rack, pinion, worm wheel, and range drum.

The sight bar is a hollow steel tube. The elevating rack is attached to the rear end of the bar, which is also provided on its underside with a lug by which it is pivoted to the carrier. The front sight is in the form of a thin blade terminating in a round bead. The rear

sight consists of two vertical sides and a horizontal crosspiece which together form an H-shaped opening. A horizontal screw is provided by means of which the rear sight can be moved 2° in deflection in either direction.

The carrier is a forged-steel piece which is bolted to the cradle and carries at its upper end the sight bar and at its rear end the sight elevating apparatus. This apparatus consists of an elevating rack attached to the sight bar and a pinion attached to the carrier. The pinion is operated by a small handwheel.

The range drum is located with its axis perpendicular to the axis of the sight bar and is secured to the sight carrier. It is actuated from the handwheel by means of a worm and worm wheel. A German-silver range scale graduated in yards is attached to the circumference of the range drum by means of four set screws.

To adjust the range scale, proceed as follows, viz: Set the sight so that the scale on the elevation rack reads zero, loosen the set screws that secure the range scale, rotate the graduated ring until its zero line coincides with the index, then tighten the set screws.

NIGHT SIGHTS.

A set of night sights consists of the following principal parts, viz:

Rear-sight fitting, containing lamp, lamp holder, and ebonite connection with split points.

Fore-sight fitting, containing lamp, glass cone, lamp holder, and ebonite connection with split points.

Two cables with plug connection at one end, the other end being passed through the lamp-holder gland, and fixed to the ebonite connection.

A battery box with two rheostats thereon.

Ten O. K. dry batteries, No. 4.

The sight proper consists of two small fittings, which are easily attached to the front and rear sights. A minute point or line of light is obtained at each sight by permitting the rays from small electric lamps to pass through a small glass lens on the fore sight and to illuminate the crossbar of the rear sight. By means of adjustable resistances the lights can be modulated to suit the eye of the observer and the degree of darkness of the night. It is found in practice that the smallest quantity of light compatible with distinguishing the sight is best, as the eye is not dazzled thereby.

A night-sight battery consists of ten O. K. dry batteries, No. 4, which are inclosed in a battery box, carried in a bracket on the left side of the carriage. When in good condition four of these cells should be connected in series on each lamp circuit, the other two being held in reserve. The reserve cells should be put into the circuit only when the four cells cease to light the lamps properly.

On putting the lights in action, the operator should see that the resistance pointers are at "off" (the commencement of the arrow), before pushing in the terminal plug for making the circuit, and should then move the pointer carefully in the direction of the arrow, until the desired brilliancy is acquired at each sight. The circuit should be broken by removing the terminal plug immediately after firing has ceased, as otherwise the battery will be unnecessarily run down. The lamp of the rear sight may be readily removed for the purpose of observing the range and deflection scales while adjusting the settings.

Approximate weights of the principal parts of 6-inch barbette carriage, Armstrong.

	Pounds.
Cradle	3,525
Pivot yoke	3,875
Pedestal	2,300
Shield	10,000

TO MOUNT THE CARRIAGE.

1. This carriage is provided with a bedplate which is counter-bored on top to receive the pedestal. The bedplate should be lowered into place over the foundation bolts and carefully leveled by the use of wedges. After it is properly leveled it should be grouted and allowed to set until the grout is hardened, so that it will not settle when the weight of the carriage and gun is added.

2. The pedestal is brought into position and lowered into its recess in the bedplate by use of a garrison gin or a derrick, and the nuts of the foundation bolts screwed tight. The level of the pedestal should now be tested by placing a level across the top, and if it is found to be out it can be adjusted by placing thin strips of tin or brass between the pedestal and the bedplate.

3. The ball bearing for the pivot yoke is next assembled, taking care to see that the balls are clean and well lubricated. Then assemble the traversing worm gear to the top of the pedestal.

4. *Pivot yoke.*—Raise the pivot yoke by a gin or a derrick over the pedestal and lower it carefully into its position, being careful that it does not jam against the sides of the pedestal.

5. The cradle is next brought into position at a point in the rear of the pivot yoke. Before assembling place the trunnion blocks over the trunnion of the cradle. These blocks being right and left, be careful to get on the proper side. The trunnion blocks should also have the locking levers assembled in them, as they can not be put in position when the cam in the block is in the unlocked position.

Now move the cradle ahead and enter into the pivot yoke until the screw on top of the yoke may be swung down and engaged in the

trunnion block. After this pull the cradle ahead by tightening on the nuts of these screws until the block is brought home or until the locking cam is opposite its slot in the pivot yoke. This can be determined, if the shield and braces are not mounted, by observing the slot for the cam which extends through the pivot yoke, or, if the shield and parts are mounted, by bearing down on the locking levers when the cam is opposite the slot it will drop in.

The cradle is now locked to the pivot yoke and the locking handle can be removed.

The locking levers are provided with a key that will not allow them to be withdrawn when the locking cam is in the unlocked position. The locking point is shown by an arrow on the collar of the lever which, when the cradle is locked in the pivot yoke, points to an arrow on the trunnion blocks.

After the cradle has been mounted the locking levers should be removed from the carriage and kept in the ordnance storehouse, so that persons not familiar with the mount can not unlock the cradle from the pivot yoke, for if the gun is fired in the unlocked position there is nothing to hold the cradle in position except the screw on the top of the pivot yoke.

6. The shield and its supports are now moved into position and bolted to the pivot yoke.

7. The gun is mounted by pushing the muzzle through the cradle, care being taken to see that blocking is placed so as to support the rear end of the cradle and that the gun is perfectly in line with the bore of the cradle. After the gun is pushed home assemble the spring yoke, piston-rod nuts, and spring rods.

8. The gunner's platform brackets, traversing and elevating mechanism may now be assembled. The sights should be lined and adjusted by use of bore sight.

CARE OF THE CARRIAGE.

Carriages should be traversed from time to time throughout their entire allowed movement.

It is especially required that all parts of carriages be kept free from rust at all times. If this be allowed to accumulate its removal from all bearing parts, and especially the piston rod, requires care in order that the clearances may not be unduly increased. The use of sandpaper in removing rust from bearing surfaces is forbidden, and emery cloth No. 1, being coarse enough for ordinary rusting, should be used.

If any leakage occurs from the hydraulic recoil system, it should be immediately remedied, calling, if necessary, upon the district armament officer for the services of skilled labor. The repacking of

stuffing boxes may be done, when necessary, by trained enlisted men under supervision of an officer, but will preferably be done by skilled labor. Before drawing a piston rod through a stuffing box the pressure of the packing on the rod should be released by unscrewing the follower several turns.

Recoil cylinders.—Recoil cylinders should be emptied at least every three months and thoroughly cleaned every six months. Experience has indicated that oil should not be removed from the recoil cylinders when carriages are to remain unused for a considerable period, as the walls of the cylinders soon become dry and then rust.

Oil holes.—Oil holes, where provided, must be cleaned out frequently to keep them free from sand and grit. *Before oiling at any oil hole wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.*

For further information regarding paints, oils, cleaning materials, and methods of using same see Ordnance Department Pamphlet Form No. 1869. Annual allowances will also be found in this pamphlet.

INSTRUCTIONS FOR FILLING SHELLS.

STRONG-HEADED AND COMMON.

Unscrew and remove the plug from the shell. Place the filling rod in the bag and fold the latter round the rod; insert it through the plug hole, taking care not to force the end of the rod through the bottom of the bag; carefully push in the bag until the neck only is in the plug hole, a portion being kept outside, as the whole bag must not be allowed to slip into the shell during the operation of filling; then withdraw the rod and insert the funnel into the neck of the bag, pressing the funnel well down into the plug hole; pass the filling rod through the funnel and gradually pour in a small quantity of the powder (say about half the charge); take out the funnel and rod, lift up the bag and jerk it, so as to "set" the powder well down to the bottom and to open the bag; then reinsert the funnel and rod as before, and continue the filling; choke the bag and cut off the superfluous choke. The filling rod should be moved up and down while pouring in the powder, to facilitate its passage through the funnel, the powder in the shell being tamped on at the same time. The use of a large mallet against the side of the shell (any piece of wood will answer the same purpose) will materially assist in getting the maximum amount of powder into the shell.

When filling with P. and F. G. powder, the shell should be first filled with pebble, as above described, and the interstices then filled with F. G. powder, well shaken down.

When the shell is quite full withdraw the funnel and filling rod and tie the neck of the bag with two hitches of twine close to the top of the plug hole. Cut off the superfluous choke and push the neck of the bag well down the plug hole into the shell, then screw in the plug as required.

Lead rings are supplied for the armor-piercing shell. The ring is hammered into the recess round the head of the plug and the superfluous metal removed.

No preparation of the bag by pricking or otherwise is necessary.

When empty shells are kept at the guns where the plug is liable to become set by corrosion from the action of the salt water, it should be unscrewed once at least every six months and the screw coated with a mixture of white lead and tallow.

When a bursting charge of mixed P. and F. G. powder is used the shell should be first filled with pebble, as described, and the interstices then filled with F. G. powder, well shaken down.

SHRAPNEL SHELL.

Remove the plug from the fuse hole, and after seeing that the fuse hole is clear from dirt, grit, etc., insert the funnel and pour in the bursting charge. Take care that none of the powder is left on the threads of the fuse hole; then screw in the fuse or plug as required.

BALLISTICS.

Charge (cordite)-----	pounds--	13½
Projectile-----	pounds--	100
Velocity-----	feet per second--	2,154
Energy-----	foot-tons--	3,217
Penetration-----	inches--	15.6

BURSTING CHARGES FOR SHELL.

Common cast iron-----	{ 3 lbs. 12 oz. P.
	{ 1 lb. F. G.
Common cast steel-----	{ 7 lbs. 6 oz. P.
	{ 2 lbs. 7 oz. F. G.
Common strong-headed steel-----	{ 3 lbs. 10 oz. P.
	{ 1 lb. 4 oz. F. G.

A small lighting-up charge of 1½ ounces F. G. powder is made up with the cartridge near the primer, to quickly ignite the cordite.

INSTRUCTIONS FOR PREPARING AND FIXING FUSES.

BASE CONCUSSION.

(Plate III.)

For use with strong-headed and cast-iron common shell, intended to burst on impact or light graze.

This fuse is simply screwed firmly into the shell by means of the key, and the lead cap pressed into the recess around the fuse head.

PERCUSSION DIRECT ACTION.

(Plate III.)

For use with cast-steel common shell, intended to burst on impact or light graze.

This fuse requires no preparation beyond removing the safety plug *E* at the moment of loading, by means of the fuse key. It is then screwed firmly into the shell by means of the key.

INSTRUCTION FOR FILLING AND MAKING UP 6-INCH CORDITE CARTRIDGES.

Weigh out the lighting-up charge, $1\frac{1}{4}$ ounces F. G. powder; fill the lighter bag on the end of the cartridge bag, and choke it by stitching it up.

Weigh out the gun charge, $13\frac{1}{4}$ pounds cordite, and put it into the cartridge bag, choke the bag, and tie up the braids so as to make a firm cartridge.

The bag is inserted (the end with lighter downward) into the case and gently dropped down against the primer and the lid of the case fitted into the mouth and sealed, as described on pages 8 and 9.

No. 52328.

RANGE TABLE FOR 6-INCH (152-MM.) QUICK-FIRING GUN.

Caliber of gun	6 inches (152 mm.).
Weight of gun	6.6 tons (6,705 k.).
Length of bore	40 calibers.
Charge (cordite)	$13\frac{1}{4}$ lbs. (6.0 k.).
Projectile	100 lbs. (45.4 k.).
Muzzle velocity	2,154 f. s. (657 m. s.).

Range.	Elevation.	Slope of descent.	Remaining velocity.	Five minutes' elevation will alter range by—	Five minutes will alter point of impact vertically or laterally at each range by—	Time of flight.
<i>Yards.</i>	<i>Deg. Min.</i>	<i>1 in—</i>	<i>F. S.</i>	<i>Yards.</i>	<i>Yards.</i>	<i>Seconds.</i>
100	0 4	687	2, 120	125	0. 14	0. 16
200	0 9	381	2, 090	125	0. 29	0. 31
300	0 13	245	2, 060	125	0. 43	0. 47
400	0 17	190	2, 030	125	0. 58	0. 62
500	0 21	156	2, 000	125	0. 72	0. 78
600	0 26	127	1, 970	125	0. 87	0. 95
700	0 30	110	1, 940	125	1. 01	1. 11
800	0 34	98	1, 910	125	1. 16	1. 28
900	0 39	85	1, 880	125	1. 31	1. 44
1, 000	0 43	78	1 854	125	1. 45	1. 61

Range.	Elevation.	Slope of de- scend.	Remaining velocity.	Five min- utes eleva- tion will alter range by—	Five min- utes will alter point of impact vertically or later- ally at each range by—	Time of flight.
<i>Yards.</i>	<i>Deg. Min.</i>	<i>1 in—</i>	<i>F. S.</i>	<i>Yards.</i>	<i>Yards.</i>	<i>Seconds.</i>
1, 100	0 47	71	1, 828	125	1. 60	1. 78
1, 200	0 51	66	1, 800	125	1. 74	1. 95
1, 300	0 54	61	1, 775	125	1. 89	2. 12
1, 400	0 59	56	1, 748	125	2. 03	2. 30
1, 500	1 3	52	1, 720	125	2. 18	2. 47
1, 600	1 7	48	1, 695	125	2. 32	2. 65
1, 700	1 11	43	1, 670	125	2. 47	2. 84
1, 800	1 16	40	1, 645	100	2. 61	3. 03
1, 900	1 22	37	1, 620	100	2. 76	3. 23
2, 000	1 27	34	1, 592	100	2. 91	3. 41
2, 100	1 32	32	1, 568	100	3. 05	3. 60
2, 200	1 37	30	1, 540	100	3. 20	3. 80
2, 300	1 42	28	1, 520	100	3. 34	4. 00
2, 400	1 47	26	1, 495	100	3. 49	4. 20
2, 500	1 53	24	1, 470	100	3. 63	4. 40
2, 600	1 58	23	1, 445	100	3. 78	4. 60
2, 700	2 4	21	1, 425	80	3. 92	4. 80
2, 800	2 11	20	1, 400	80	4. 07	5. 00
2, 900	2 17	19	1, 380	80	4. 21	5. 22
3, 000	2 24	18	1, 360	80	4. 36	5. 45
3, 100	2 31	17	1, 335	80	4. 51	5. 67
3, 200	2 39	16	1, 315	80	4. 65	5. 90
3, 300	2 45	15	1, 295	80	4. 80	6. 12
3, 400	2 52	14	1, 275	70	4. 94	6. 35
3, 500	2 59	13	1, 255	70	5. 09	6. 57
3, 600	3 6	13	1, 235	70	5. 23	6. 80
3, 700	3 14	12	1, 215	63	5. 38	7. 04
3, 800	3 23	12	1, 200	63	5. 52	7. 28
3, 900	3 31	11	1, 185	63	5. 67	7. 53
4, 000	3 39	10	1, 172	63	5. 81	7. 78
4, 100	3 47	10	1, 160	63	5. 96	8. 03
4, 200	3 56	9	1, 150	63	6. 11	8. 28
4, 300	4 4	9	1, 140	63	6. 25	8. 55
4, 400	4 13	9	1, 130	63	6. 40	8. 82
4, 500	4 21	8	1, 115	57	6. 54	9. 09
4, 600	4 30	8	1, 100	56	6. 69	9. 36
4, 700	4 38	8	1, 090	55	6. 83	9. 63
4, 800	4 47	7	1, 080	54	6. 98	9. 90
4, 900	4 56	7	1, 070	53	7. 13	10. 18
5, 000	5 5	7	1, 060	52	7. 27	10. 46
5, 100	5 14	7	1, 050	51	7. 42	10. 74
5, 200	5 23	6	1, 040	50	7. 56	11. 02
5, 300	5 32	6	1, 030	49	7. 71	11. 31
5, 400	5 41	6	1, 020	48	7. 85	11. 60
5, 500	5 50	6	1, 010	47	8. 00	11. 89
5, 600	6 0	6	1, 000	46	8. 14	12. 18
5, 700	6 10	5	990	45	8. 29	12. 47
5, 800	6 20	5	980	43	8. 43	12. 76
5, 900	6 31	5	970	42	8. 58	13. 08
6, 000	6 42	5	960	41	8. 73	13. 39

Range.	Elevation.	Slope of de- scend.	Remaining velocity.	Five min- utes eleva- tion will alter range by—	Five min- utes will alter point of impact vertically or later- ally at each range by—	Time of flight.
<i>Yards.</i>	<i>Deg. Min.</i>	<i>1 in—</i>	<i>F. S.</i>	<i>Yards.</i>	<i>Yards.</i>	<i>Seconds.</i>
6,100	6 54	5	950	39	8.87	13.70
6,200	7 6	5	940	38	9.01	14.02
6,300	7 18	5	930	37	9.16	14.35
6,400	7 30	4	925	36	9.30	14.69
6,500	7 43	4	920	36	9.45	15.03
6,600	7 56	4	915	35	9.60	15.38
6,700	8 9	4	910	35	9.74	15.73
6,800	8 23	4	900	34	9.89	16.08
6,900	8 47	4	893	34	10.03	16.44
7,000	8 51	4	885	33	10.18	16.80
7,100	9 5	4	878	33	10.32	17.16
7,200	9 20	3	870	33	10.46	17.52
7,300	9 35	3	866	33	10.60	17.88
7,400	9 50	3	862	33	10.75	18.25
7,500	10 5	3	856	33	10.89	18.62
7,600	10 20	3	850	32	11.04	19.00
7,700	10 35	3	845	32	11.19	19.37
7,800	10 50	3	840	32	11.34	19.75
7,900	11 6	3	835	32	11.48	20.12
8,000	11 21	3	830	32	11.63	20.50
8,100	11 37	3	825	31	11.77	20.88
8,200	11 52	3	820	31	11.92	21.26
8,300	12 7	3	815	30	12.07	21.64
8,400	12 23	2	810	30	12.22	22.02
8,500	12 38	2	805	30	12.36	22.40
8,600	12 54	2	800	30	12.50	22.78
8,700	13 9	2	795	30	12.65	23.16
8,800	13 25	2	790	29	12.80	23.55
8,900	13 41	2	785	29	12.94	23.93
9,000	13 58	2	780	28	13.08	24.31
9,100	14 14	2	775	27	13.23	24.69
9,200	14 31	2	770	27	13.37	25.07
9,300	14 48	2	765	27	13.52	25.45
9,400	15 6	2	760	27	13.66	25.83
9,500	15 24	2	755	26	13.81	26.21
9,600	15 42	2	750	26	13.96	26.60
9,700	16 0	2	745	26	14.11	26.98
9,800	16 19	2	740	25	14.26	27.36
9,900	16 38	2	735	25	14.40	27.74
10,000	16 57	2	730	25	14.55	28.12

PENETRATION OF W. I. PLATE.

At muzzle.....	inches..	15.6
At 1,000 meters.....	inches..	12.5
At 2,000 meters.....	inches..	10.0
At 3,000 meters.....	inches..	7.8
At 4,000 meters.....	inches..	6.3
At 5,000 meters.....	inches..	5.4

*List of articles packed in the armament chest for 6-inch R. F. gun, Armstrong,
and Barbette Carriage, Armstrong.*

NOTE.—All articles marked thus * are carried loose in the chest.

For gun :

- 1 cartridge case clip.
- 1 quire emery cloth, No. 00.
- 1 drift 2.7 long.
- 1 drift 5. long.
- 1 drift 7.25 long.
- 1 bronze drift for removing hinge pin.
- 3 files, pillar No. 6, 6-inch.
- 3 files, three-cornered, No. 4, 6-inch.
- 3 files, half-round, smooth, 8-inch.
- 3 files, round, smooth, 8-inch.
- 1 file, flat, dead smooth, 8-inch.
- 1 file, round, second cut, 8-inch.
- 1 file, half-round, smooth, 8-inch.
- 1 file, three-cornered, 8-inch.
- 1 boilermaker's hammer.
- 1 copper hammer.
- 1 hand extractor.
- * 1 lanyard and handle.
- 1 hand mallet.
- 1 long-handled mallet.
- 1 pair cutting pliers, 7-inch.
- * 1 gunner's pouch.
- 1 metal scraper.
- * 1 pair gunner's sleeves.
- 1 spanner for firing mechanism and cable coupling.
- * 3 wagon sponges.
- * 4 balls twine, assorted.
- * 10 pounds cotton waste.
- * 2 pounds copper wire, No. 12.
- * 2 pounds copper wire, No. 16.
- 1 wrench for breech mechanism.
- 1 wrench for extractor cover bolts and bushing.

For use on bruised breechblocks.
No other files to be used thereon.

For carriage :

- 1 eyebolt for lifting pedestal and shield.
- 1 filling funnel.
- 1 monkey wrench, 21-inch.
- 1 monkey wrench, 18-inch.
- 1 oiler, half-pint.
- * 1 oiler, locomotive, 1 quart.
- 1 screw driver, commercial, 5-inch blade.
- 1 screw driver, for drain, air, and filling plugs.
- 1 shackle, pin and lifting eye for cradle.
- 1 spanner for cylinder-head and piston-rod gland.
- 1 wrench for compressor plate and spring cover.
- 1 wrench and screw driver for guard screws and tank plugs.
- 1 wrench for spring guide rod.
- 1 wrench for sights.
- 1 wrench for plunger controller and cradle lubricator.

The following, being too large, are not carried in the chest: Two water buckets, indurated fiber.

List of implements furnished for 6-inch gun, Armstrong.

- 1 rammer and staff.
- 1 sponge and staff, bore.
- 1 breech cover.
- 1 combined tomplon and muzzle cover.
- 1 slush brush with handles to connect with special sponge staff.
- 1 steel scraper and socket to fit special sponge staff.

WAR DEPARTMENT,

OFFICE OF THE CHIEF OF ORDNANCE,

Washington, April 28, 1908.

May 21, 1903.

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PLATE I.

